

# How Hardware Manufacturing Works

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## Moore's Law and Integrated Circuits

The development of **integrated circuits** (IC) started in the **1940s** with thousands of **discrete components**, such as **transistors**, soldered and wired together. Crash Course's #17 video [Integrated Circuits and Moore's Law](#), explains that in the 1950s transistors provided **six times the speed** and were smaller and more reliable than vacuum tubes. In the 1960s, all the discrete parts were **built as one** in an integrated circuit. **Silicon wafers** became the material of choice for the circuits due to its availability and stability. Noyce became known as the father of ICs. Then in the later 1960s, engineers **printed** all the **circuits on boards** (PCB) to eliminate wiring and soldering in favor of etching, photoresist, photomask, doping, and metallization. **Moore's Law** is the phenomenon that ICs reduce in size by half and increase by 2 in computer power every 2 years. These smaller ICs took less time to calculate, less power to run, and generated less heat. Moore teamed with Noyce to found **Intel**, the largest IC maker worldwide with the '**microprocessor**'. By 2010, engineers could fit **1 billion transistors** in one Integrated Circuit! An iPhone processor includes more than **3 billion transistors**. To get that many on an IC, **VLSI software** is used to design the circuits before they are printed. **Quantum tumbling** is occurring on micro-sized components, which will mean that future high-powered processors will need some other technology to double current computing speeds.

## Circular Economies

[From linear to circular—Accelerating a proven concept](#) ..cover these topics in detail: **restorative** and **regenerative circular economies**...

## Electronic Waste

[Tech companies aren't doing enough to keep their devices out of landfills, and neither are we](#) ...cover these topics in detail: **global electronic waste problems and solutions**....

## Timeline Entry



### **Ada Lovelace invents computer programming**

Ada Lovelace invented Computer Programming in 1843. Lovelace interprets the notes of Charles Babbage related to his Difference Engine, an early computer. She explains its complex potential and writes detailed instructions for its use a century before they are realized in modern computer programming. Programming is the devising of algorithms to calculate complex sequences of actions. Computers eventually impact the carbon footprint of nearly everyone on earth by increasing mining of precious metals and data center

energy usage. Social communication styles eventually change from face-to-face interactions to online interactions and robots take the place of human workers. Autonomous features in modes of transportation begin to phase out human drivers. Computer scientists begin work on quantum computing and the singularity is in sight.

Movie URL: <https://youtu.be/uBbVbqRvqTM>

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Caption for the image: Ada Lovelace was the first author of a computer program for Charles Babbage's Difference Engine in 1843.

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